IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s): R. Laroia et al.
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Serial No.: 09/503,041
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Group: 2667
Examiner: Andrew Waxman

I hereby certify that this paper is being deposited on this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signature: Teresa M. Hanlin Date: April 5, 2004

Title: Signal Construction, Detection and Estimation for Uplink Timing Synchronization and Access Control in a Multi-Access Wireless Communication System

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants hereby appeal the final rejection dated October 31, 2003 of claims 1-23 and 25-39 of the above-identified application.

REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., as evidenced by an assignment recorded February 11, 2000 in the U.S. Patent and Trademark Office at Reel 010635, Frame 0580. The assignee Lucent Technologies Inc. is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

STATUS OF CLAIMS

The present application was filed on February 11, 2000 with claims 1-47. Claims 40-47 were canceled in an amendment dated August 7, 2003. Claims 1-39 are currently pending in the application, with claims 1 and 35-39 being the independent claims.

Each of claims 1-23 and 25-39 stands finally rejected under either 35 U.S.C. §102(e) or 35 U.S.C. §103(a). Dependent claim 24 is indicated as being allowable if rewritten in independent form. Claims 1-23 and 25-39 are appealed.

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF INVENTION

The present invention is directed to arrangements for transmission or reception of at least one of an uplink access signal and an uplink timing synchronization signal in a wireless communication system comprising a base station and a mobile station. The "uplink" refers to communication in the direction from the mobile station to the base station. In accordance with the invention, the uplink access signal or uplink timing synchronization signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

Illustrative examples of such uplink access signal and uplink timing synchronization signals are described in conjunction with FIGS. 1 and 2 of the drawings, and the corresponding text at page 6, line 7, to page 9, line 7, of the specification.

In one particular embodiment, an uplink access signal or uplink timing synchronization signal may be of the form given by Equation (1) on page 6 of the specification. As indicated on page 7, lines 16-19, different access and timing signals use different non-overlapping sets of tone frequencies $\omega_1, \ldots \omega_M$. The tone frequencies $\omega_1, \ldots \omega_M$ and the coefficients a_m may be selected using criteria such as time resolvability or peak-to-average ratio, as is described in greater detail at page 9, line 9, to page 12, line 21.

Advantageously, the uplink access signals and uplink timing synchronization signals of the present invention are less susceptible to the deleterious effects of channel fading, multipath delay spread and interference. See the specification at, for example, page 2, lines 1-26. The invention thus provides improved performance in multiple access wireless communication systems, and more particularly in multiple access systems based on orthogonal frequency division multiplexing (OFDM).

ISSUES PRESENTED FOR REVIEW

1. Whether claims 1, 8, 9, 11-13, 18 and 35-39 are anticipated under 35 U.S.C. §102(e) by U.S. Patent No. 5,970,047 (hereinafter "Suzuki").

2. Whether claims 2-7, 10, 14, 15, 21-23, 25 and 26 are unpatentable under 35 U.S.C. §103(a) over Suzuki in view of U.S. Patent No. 6,546,055 (hereinafter "Schmidl").

3. Whether claims 16 and 27-34 are unpatentable under 35 U.S.C. §103(a) over Suzuki in view of U.S. Patent No. 5,930,308 (hereinafter "Schmutz").

4. Whether claim 17 is unpatentable under 35 U.S.C. §103(a) over Suzuki in view of Schmutz and in further view of U.S. Patent No. 6,330,294 (hereinafter "Ansbro").

5. Whether claim 19 is unpatentable under 35 U.S.C. §103(a) over Suzuki in view of U.S. Patent No. 6,560,209 (hereinafter "Alamouti").

6. Whether claim 20 is unpatentable under 35 U.S.C. §103(a) over Suzuki.

GROUPING OF CLAIMS

With regard to Issue 1, claims 1, 8, 9, 11 and 35-39 stand or fall together, claim 12 stands or falls alone, claim 13 stands or falls alone, and claim 18 stands or falls alone.

With regard to Issue 2, claim 2 and 21-23 stand or fall together, claims 3 and 4 stand or fall together, claim 5 stands or falls alone, claim 6 stands or falls alone, claim 7 stands or falls alone, claim 10 stands or falls alone, claim 14 stands or falls alone, claim 15 stands or falls alone, claim 25 stands or falls alone, and claim 26 stands or falls alone.

With regard to Issue 3, claims 16 and 27-29 stand or fall together, claim 30 stands or falls alone, claim 31 stands or falls alone, claim 32 stands or falls alone, claim 33 stands or falls alone, and claim 34 stands or falls alone.

With regard to Issue 4, claim 17 stands or falls alone.

With regard to Issue 5, claim 19 stands or falls alone.

With regard to Issue 6, claim 20 stands or falls alone.

ARGUMENT

Issue 1

Applicants initially note that the Manual of Patent Examining Procedure (MPEP), Eight Edition, August 2001, §2131, specifies that a given claim is anticipated "only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference," citing Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Moreover, MPEP §2131 indicates that the cited reference must show the "identical invention . . . in as complete detail as is contained in the . . . claim," citing Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). For the reasons identified below, Applicants submit that the Examiner has failed to establish anticipation of at least independent claims 1 and 35-39 by the Suzuki reference.

Independent claim 1 is directed to a method for use in a wireless communication system. The claim calls for transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system. The claim further specifies that the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

As indicated above, illustrative examples of such uplink access signal and uplink timing synchronization signals are described in conjunction with FIGS. 1 and 2 of the drawings, and the corresponding text at page 6, line 7, to page 9, line 7, of the specification.

The Examiner in formulating the §102(e) rejection over Suzuki argues that the claimed uplink access signal and uplink timing synchronization signal configurations are disclosed in the U0 to U5 timing arrangement shown in FIGS. 3A-3G of Suzuki, and in the associated text at column 4, lines 39-46. Applicants respectfully disagree. There is no teaching or suggestion in the cited portions of Suzuki regarding the particular limitation in question, that is, an uplink access signal or an uplink timing synchronization signal from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

The particular cited portions of the Suzuki reference relied on by the Examiner do not relate to uplink access signals or uplink timing synchronization signals, but instead relate only to uplink and downlink data transmission. Suzuki in fact teaches away from the claimed invention by teaching that the mobile stations synchronize to signals transmitted from the base station during a timing processing period which is clearly described as falling outside of the time slots T or R of FIGS. 3A-3G. This is apparent from column 5, lines 15-30 of Suzuki, which provides the following disclosure, with emphasis supplied:

> Each mobile station has an allowance of two time slot period (i.e., 400 μsec.) from completion of reception and transmission of one time slot period to the next execution of transmission and reception. Each mobile station carries out a timing processing and a processing called a frequency hopping by using the allowance. That is, during about 200 μsec. before each transmission slot T, the mobile station carries out a timing processing TA in which a transmission timing is synchronized with a timing of a signal transmitted from the base station side. After about 200 μsec. when each transmission slot T terminates, a frequency hopping in which a band slot for carrying out signal transmission and reception is changed to another band slot, is carried out. Owing to the frequency hopping, a plurality of band slots prepared in one base station are utilized uniformly by respective mobile stations, for example.

It appears from the above-quoted portion of Suzuki that the Suzuki arrangements utilize a different type of timing synchronization than the claimed invention. There is no particular disclosure in Suzuki regarding an uplink access signal or uplink timing synchronization signal of the type claimed, and Suzuki actually teaches away from the claimed arrangements by teaching synchronization of the mobile stations with a downlink signal transmitted by the base station outside of the particular T or R time slots shown in FIGS. 3A-3G.

The Examiner in the final Office Action at page 10, last paragraph, argues that the claimed uplink timing synchronization signal is met by pilot signals inherently disclosed in Suzuki. More specifically, the Examiner states as follows:

> Therefore, it is inherent to Suzuki that in every signal transmitted, from mobile station to base station, there will be uplink timing synchronization signals (pilots).

Applicants respectfully disagree. Applicants initially note that the term "pilot" is apparently not mentioned anywhere in the text of the Suzuki reference, and is certainly not described therein as being utilizable for uplink timing synchronization as alleged. Thus, it appears that the Examiner is relying on teachings that are not present in the Suzuki reference, although the claim at issue is rejected as being anticipated by Suzuki. Moreover, as Applicants described above, Suzuki explicitly teaches an entirely different type of timing synchronization, namely, an arrangement in which mobile stations synchronize to signals transmitted from the base station during a particular timing processing period TA prior to a transmission time slot T. More specifically, Suzuki in column 5, lines 15-30 states that the mobile station "carries out a timing processing TA in which a transmission timing is synchronized with a timing of a signal transmitted from the base station side." Such a teaching is directly contrary to the above-quoted inherency argument made by the Examiner. The inherency argument is therefore believed to be improper. The Suzuki reference does not explicitly or inherently disclose the claimed arrangement involving transmission of at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system, where the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at

least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

Since Suzuki fails to meet at least the limitations of claim 1 regarding uplink access signal or uplink timing synchronization signal configuration, claim 1 is not anticipated by Suzuki.

Independent claims 35-39 each include limitations similar to those of claim 1 as described above, and are therefore believed allowable over Suzuki for substantially the same reasons that claim 1 is believed allowable over Suzuki.

Dependent claims 8, 9, 11-13 and 18 are believed allowable at least by virtue of their dependence from independent claim 1. Moreover, these claims are believed to define additional separately-patentable subject matter relative to Suzuki, as will be described in greater detail below.

With regard to claim 12, this claim specifies that the mobile station computes a multitone timing and access signal using an inverse fast Fourier transform (IFFT) that is also used for data transmission. Suzuki fails to meet this limitation.

With regard to claim 13, this claim specifies that the mobile station pre-computes a multitone timing and access signal and stores it in a memory associated with the mobile station. The particular pre-computation and storage operations claimed are not shown in Suzuki.

With regard to claim 18, this claim specifies that at least a subset of the timing and access signals comprise multitone signals, and that the tone frequencies of a given one of the multitone signals are spread throughout a designated frequency spectrum for purposes of frequency diversity. Again, the particular multitone signal configuration claimed is not shown in Suzuki.

Issue 2

Applicants respectfully submit that the Schmidl reference fails to supplement the above-described fundamental deficiency of Suzuki as applied to claim 1.

Dependent claims 2-7, 10, 14, 15, 21-23, 25 and 26 are therefore believed allowable at least by virtue of their dependence from independent claim 1. Moreover, these claims are believed to define additional separately-patentable subject matter relative to the proposed combination of Suzuki and Schmidl, as will be described in greater detail below.

Applicants further note that the Examiner has failed to demonstrate the requisite motivation for combining the Suzuki and Schmidl references or modifying their teachings to reach the limitations in question.

The Federal Circuit has stated that when patentability turns on the question of obviousness, the obviousness determination "must be based on objective evidence of record" and that "this precedent has been reinforced in myriad decisions, and cannot be dispensed with." In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002). Moreover, the Federal Circuit has stated that "conclusory statements" by an examiner fail to adequately address the factual question of motivation, which is material to patentability and cannot be resolved "on subjective belief and unknown authority." Id. at 1343-1344. There has been no showing in the present §103(a) rejections of objective evidence of record that would motivate one skilled in the art to combine Suzuki with Schmidl, or to modify the proposed combinations to produce the particular limitations in question. On the subject of motivation to combine Suzuki and Schmidl, the Examiner states as follows at page 5, paragraphs 2-3, of the Office Action, with emphasis supplied:

> Therefore at the time the invention was made it would have been obvious to one of ordinary skill in the art to have combined the invention as disclosed by Schmidl, and the invention as disclosed by Suzuki.
>
> One of ordinary skill in the art would have been motivated to do this in order to perform the combined process of managing multiple signals while maximizing the speed and processing of the signals and minimizing the interference and probable errors.

The above-quoted statement of obviousness provided by the Examiner is precisely the type of subjective, conclusory statement that the Federal Circuit has indicated provides insufficient support for an obviousness rejection. The alleged motivation provided is nothing more than recitation of a potential advantage that may be associated with the claimed arrangements, and does not constitute the required objective evidence of record. The absence of any such objective evidence instead suggests that the Examiner has simply undertaken a piecemeal reconstruction of the claimed invention, given the benefit of access to the disclosure provided by Applicants.

With regard to claim 3, this claim specifies that the signal set comprises a plurality of multitone signals, with each of at least a subset of the multitone signals comprising a linear combination of tones whose baseband frequencies are integer multiples of $1/T$, where T is the base station sample window size. The proposed combination of Suzuki and Schmidl simply fails to meet the particular limitations in question.

With regard to claim 5, this claim specifies that each timing and access signal comprises a single multitone signal with different signals using non-overlapping subsets of tones, and further that the tones from all of the timing and access signals span the total available bandwidth. The proposed combination of Suzuki and Schmidl does not teach or suggest such limitations.

With regard to claim 6, this claim specifies that the multitone signals are transmitted with a cyclic prefix sufficiently large to cover multipath dispersion and pre-synchronization timing errors. Again, the proposed combination of Suzuki and Schmidl fails to meet the particular arrangement set forth in the claim.

With regard to claim 7, this claim specifies that the cyclic prefix is larger than a cyclic prefix used in data symbols transmitted from mobile stations that are already synchronized. There is no disclosure in the combined teachings of Suzuki and Schmidl regarding the particular cyclic prefix size relationship recited in the claim.

With regard to claim 10, this claim specifies that the base station sample window is located within a designated timing and access interval, such that, for all possible multipath signal arrival times, the sample window captures one T -period of the steady-state sinusoidal response to the multitone signal, where T is the base station sample window size. Again, Applicants have been unable to find these particular limitations in the proposed combination of Suzuki and Schmidl.

With regard to claim 14, this claim specifies that each of at least a subset of the timing and access signals comprises a sequence of L multitone signals transmitted sequentially, with different timing and access signals using non-overlapping subsets of tones in each of L sample windows, and with the base station taking a T -length sample from each of the L multitone signals, where T is the base station sample window size. These limitations are not met by the proposed combination of Suzuki and Schmidl.

With regard to claim 15, this claim specifies that at least a subset of the timing and access signals comprise multitone signals, and the coefficients of a given multitone signal are selected such that a cyclic autocorrelation of the signal at delays greater than a desired timing accuracy is sufficiently small. The proposed combination of Suzuki and Schmidl fails to teach or suggest the particular type of coefficient selection claimed.

With regard to claim 25, this claim specifies that the multipath components depend only on *u(t)* and can be pre-computed and stored by the base station. Such pre-computation and storage operations are simply not disclosed in the proposed combination of Suzuki and Schmidl.

With regard to claim 26, this claim specifies that each cross-correlation of *y(t)* with a multipath component can be computed using a single inverse fast Fourier transform (IFFT). Again, the proposed combination of Suzuki and Schmidl fail to provide any teaching regarding the particular limitation set forth in the claim.

Issue 3

Applicants respectfully submit that the Schmutz reference fails to supplement the above-described fundamental deficiency of Suzuki as applied to claim 1.

Dependent claims 16 and 27-34 are therefore believed allowable at least by virtue of their dependence from independent claim 1. Moreover, these claims are believed to define additional separately-patentable subject matter relative to the proposed combination of Suzuki and Schmutz, as will be described in greater detail below.

Applicants further note that the Examiner has failed to demonstrate the requisite motivation for combining the Suzuki and Schmutz references or modifying their teachings to reach the limitations in question. The statement of motivation provided at page 6, paragraph 4, of the final Office Action, is nothing more than a subjective, conclusory statement which fails to meet the above-described legal standard of In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

With regard to claim 30, this claim specifies that when re-synchronizations are sufficiently frequent, the mobile station can combine timing corrections obtained from different re-synchronization intervals to average out timing estimation errors. The proposed combination of

Suzuki and Schmutz fails to mention the particular combination of timing corrections that is set forth in the claim.

With regard to claim 31, this claim specifies that the combining can be performed by linearly low-pass filtering timing estimates received from the base station. Again, the proposed combination of Suzuki and Schmutz provides no teaching or suggestion regarding the particular combination technique that is claimed.

With regard to claim 32, this claim specifies that the mobile station is operative to clip timing corrections received from the base station. There is no mention in the proposed combination of Suzuki and Schmutz regarding clipping of timing corrections as claimed.

With regard to claim 33, this claim specifies that the mobile station clips the corrections by ignoring timing corrections greater than a threshold. This particular type of timing correction clipping is not met by the teachings of the proposed combination of Suzuki and Schmutz.

With regard to claim 34, this claim specifies that the mobile station clips the corrections by accepting a timing correction which is larger than a threshold only if a certain number of large values are received in succession. Again, this particular type of timing correction clipping is not met by the teachings of the proposed combination of Suzuki and Schmutz.

Issue 4

Applicants respectfully submit that the Schmutz and Ansbro references fail to supplement the above-described fundamental deficiency of Suzuki as applied to claim 1.

Dependent claim 17 is therefore believed allowable at least by virtue of its dependence from independent claim 1.

Applicants further note that the Examiner has failed to demonstrate the requisite motivation for combining the Suzuki, Schmutz and Ansbro references or modifying their teachings to reach the limitations in question. The statement of motivation provided at page 7, paragraph 4, of the final Office Action, is nothing more than a subjective, conclusory statement which fails to meet the above-described legal standard of In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

Issue 5

Applicants respectfully submit that the Alamouti reference fails to supplement the above-described fundamental deficiency of Suzuki as applied to claim 1.

Dependent claim 19 is therefore believed allowable at least by virtue of its dependence from independent claim 1.

Applicants further note that the Examiner has failed to demonstrate the requisite motivation for combining the Suzuki and Alamouti references or modifying their teachings to reach the limitations in question. The statement of motivation provided at page 8, paragraph 4, of the final Office Action, is nothing more than a subjective, conclusory statement which fails to meet the above-described legal standard of In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

Issue 6

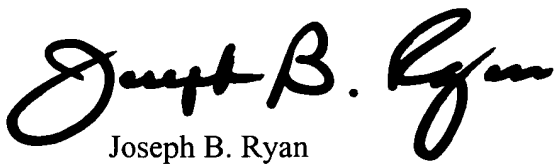
Applicants respectfully submit that the additional Suzuki teachings relied upon by the Examiner fail to supplement the above-described fundamental deficiency of Suzuki as applied to claim 1.

Dependent claim 20 is therefore believed allowable at least by virtue of its dependence from independent claim 1.

Applicants further note that the Examiner has failed to demonstrate the requisite motivation for modifying the Suzuki teachings to reach the limitations in question. The statement of motivation provided at page 9, paragraph 2, of the final Office Action, is nothing more than a subjective, conclusory statement which fails to meet the above-described legal standard of In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

In view of the above, Applicants believe that claims 1-23 and 25-39 are in condition for allowance, and respectfully request the withdrawal of the §102(e) and §103(a) rejections.

Respectfully submitted,



Date: April 5, 2004

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APPENDIX

1. (Previously amended) A method for use in a wireless communication system, comprising the step of:

transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

2. (Original) The method of claim 1 wherein the wireless system comprises an orthogonal frequency division multiplexed (OFDM) system.

3. (Original) The method of claim 1 wherein the signal set comprises a plurality of multitone signals, each of at least a subset of the multitone signals comprising a linear combination of tones whose baseband frequencies are integer multiples of $1/T$, where T is the base station sample window size.

4. (Original) The method of claim 3 wherein the sample window size T for the timing and access signals is the same as that used in the system for OFDM data symbols.

5. (Original) The method of claim 1 wherein each timing and access signal comprises a single multitone signal with different signals using non-overlapping subsets of tones, and further wherein the tones from all of the timing and access signals span the total available bandwidth.

6. (Original) The method of claim 5 wherein the multitone signals are transmitted with a cyclic prefix sufficiently large to cover multipath dispersion and pre-synchronization timing errors.

7. (Original) The method of claim 6 wherein the cyclic prefix is larger than a cyclic prefix used in data symbols transmitted from mobile stations that are already synchronized.

8. (Original) The method of claim 1 wherein a guard time of non-transmission is added to at least one of a beginning or an end of at least one of the timing and access signals to insure that the signal does not overrun into adjacent data symbols.

9. (Original) The method of claim 1 wherein during a particular timing and access interval, the base station takes a single T-length sample of a multitone timing and access signal, where T is the base station sample window size.

10. (Previously amended) The method of claim 1 wherein the base station sample window is located within a designated timing and access interval, such that, for all possible multipath signal arrival times, the sample window captures one T-period of the steady-state sinusoidal response to the multitone signal, where T is the base station sample window size.

11. (Original) The method of claim 1 wherein a base station timing and access sample window is synchronized with a data sample window of the base station.

12. (Original) The method of claim 1 wherein the mobile station computes a multitone timing and access signal using an inverse fast Fourier transform (IFFT) that is also used for data transmission.

13. (Original) The method of claim 1 wherein the mobile station pre-computes a multitone timing and access signal and stores it in a memory associated with the mobile station.

14. (Original) The method of claim 1 wherein each of at least a subset of the timing and access signals comprises a sequence of L multitone signals transmitted sequentially, with different timing and access signals using non-overlapping subsets of tones in each of L sample windows, and

further wherein the base station takes a T-length sample from each of the L multitone signals, where T is the base station sample window size.

15. (Previously amended) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and the coefficients of a given multitone signal are selected such that a cyclic autocorrelation of the signal at delays greater than a desired timing accuracy is sufficiently small.

16. (Original) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, with a given multitone signal comprising contiguous tones, such that coefficient selection for the given multitone signal can be performed using a finite impulse response (FIR) filter design procedure.

17. (Original) The method of claim 16 wherein the FIR filter design procedure comprises a Chebychev polynomial design procedure.

18. (Original) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and wherein the tone frequencies of a given one of the multitone signals are spread throughout a designated frequency spectrum for purposes of frequency diversity.

19. (Previously amended) The method of claim 18 wherein the given multitone signal comprises groups of contiguous tones, with the groups of tones separated by an amount greater than a channel coherence bandwidth.

20. (Previously amended) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and wherein the coefficients of a given one of the multitone signals are selected such that a peak-to-average ratio of the signal is minimized.

21. (Original) The method of claim 1 wherein when the mobile station transmits a timing or access signal *u(t)*, the base station uses a maximum-likelihood (ML) estimator on the received signal *y(t)* to estimate an appropriate timing correction.

22. (Original) The method of claim 21 wherein in a multipath channel, the ML estimate is the time τ which maximizes the sum of the cross-correlation energies of *y(t)* with certain multipath components of *u(t)*.

23. (Previously amended) The method of claim 1 wherein received signal power can be estimated in the base station by a measure of maximum total cross-correlation energy.

24. (Original) The method of claim 22 wherein the multipath components of *u(t)* are given as the eigenvectors of an average auto-correlation of the received signal, where the average is taken over the randomness in the multipath channel and the signal noise.

25. (Original) The method of claim 22 wherein the multipath components depend only on *u(t)* and can be pre-computed and stored by the base station.

26. (Original) The method of claim 22 wherein each cross-correlation of *y(t)* with a multipath component can be computed using a single inverse fast Fourier transform (IFFT).

27. (Previously amended) The method of claim 1 wherein the presence of a transmitted access signal *u(t)* can be detected by the base station when estimated received signal power surpasses a pre-determined energy threshold.

28. (Original) The method of claim 27 wherein the threshold can be adjusted to trade off false access detection probability and missed detection probability.

29. (Original) The method of claim 27 wherein the threshold can be increased to ensure that access signals are received with sufficient energy to allow accurate timing estimates.

30. (Original) The method of claim 1 wherein when re-synchronizations are sufficiently frequent, the mobile station can combine timing corrections obtained from different re-synchronization intervals to average out timing estimation errors.

31. (Original) The method of claim 30 wherein the combining can be performed by linearly low-pass filtering timing estimates received from the base station.

32. (Original) The method of claim 1 wherein the mobile station is operative to clip timing corrections received from the base station.

33. (Original) The method of claim 32 wherein the mobile station clips the corrections by ignoring timing corrections greater than a threshold.

34. (Original) The method of claim 32 wherein the mobile station clips the corrections by accepting a timing correction which is larger than a threshold only if a certain number of large values are received in succession.

35. (Original) A mobile station system for use in a wireless communication system, the mobile station system being operative to transmit at least one of an uplink access signal and an uplink timing synchronization signal from a corresponding mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

36. (Previously amended) An apparatus for use in a wireless communication system, the apparatus comprising:

means for transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window; and

means for generating the at least one signal to be transmitted.

37. (Previously amended) A method for use in a wireless communication system, comprising the step of:

receiving at least one of an uplink access signal and an uplink timing synchronization signal in a base station of the system from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

38. (Previously amended) An apparatus for use in a wireless communication system, the apparatus comprising:

means for receiving at least one of an uplink access signal and an uplink timing synchronization signal in a base station of the system from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window; and

means for processing the received at least one signal.

39. (Original) A base station system for use in a wireless communication system, the base station system being operative to receive at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at a corresponding base station orthogonal to one another over a base station sample window.

40. (Canceled)

41. (Canceled)

42. (Canceled)

43. (Canceled)

44. (Canceled)

45. (Canceled)

46. (Canceled)

47. (Canceled)